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### Meteorological observatories in the Atlantic Ocean

H.S.H. Albert Prince of Monaco

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It is apparent that circulation is more active on the western half-circle of the vortex than on the eastern one; and this is explained by the combined action of various causes, as the trade-winds, the equatorial currents, and the Gulf Stream, also the powerful evaporation which in the Tropics stimulates the circulation of the waters, as by the increase of density it always tends to re-establish equilibrium. It would now be of great importance to renew these experiments at different seasons.

## METEOROLOGICAL OBSERVATORIES IN THE ATLANTIC OCEAN.

(Read at Meeting of British Association, 1892.)

By H.S.H. ALBERT, PRINCE OF MONACO.

ATTENTIVE observation of the progress made by Meteorology in the last fifty years, along with the reflections suggested by my own work in the field of Oceanography, have led me to conceive a plan which, if carried out, will, I feel convinced, have a very great effect in furthering the advancement of these sister sciences.

Maury's researches on the laws of the winds furnished information of so practical a nature regarding the best track for sailing ships, that navigators were able at once to save half of the time that had been formerly required to make the passage from the United States to the Equator. Since then, and principally owing to the labours of Fitzroy, Leverrier and others, a network of observatories, which now covers all Europe, has been developed, and informs us of the simultaneous variations in the state of the atmosphere, thus enabling us to advance a certain distance in forecasting the weather. Similar observations, collected at the Weather Bureau in Washington, enable us at times to be warned of great atmospheric disturbances advancing towards us. Information, collected by the same office, from the multitude of ships which enter the ports of the United States, enables it to publish each month a *Pilot Chart*, of the greatest interest alike to mariners and meteorologists, which gives the position of the icebergs, cyclones, and wrecks met with at sea during the preceding month. It does not, however, confine itself to recording past events. By the skillful use of the large amount of material brought together, it indicates for the current month the probable limits of the fogs in certain regions of the Atlantic, and of the ice in the neighbourhood of the North American coasts; it shows also the probable direction of the winds on the whole Atlantic.

But the Atlantic is too vast a region for it to be possible to predicate what is going on in its centre from observations made on its borders; and observations made at sea, which sailors bring home, often arrive too late to be of use for forecasting. We are therefore at present very imperfectly warned of what the sea is preparing for us.

If we consider this question more closely, remembering how great

is its practical importance to maritime nations, and keeping in view the great advances in scientific methods and instruments, we shall find that places where the requisite operations could be easily made and utilised exist in some very favourable positions in the ocean: Bermuda, the Azores, the Canaries, and the Cape Verd Islands, are already, or will be shortly, connected with the Continent by telegraphic cable. It would, in the first instance, be sufficient to establish on some suitable spot in each of these groups of islands an observatory furnished with the instruments necessary for noticing the first appearance, the nature, and the march of those disturbances, which cannot be followed from the borders of the ocean.

The Cape Verd Islands have an especial interest, because they lie in the neighbourhood of the Tropic, and on the parallels where the most important cyclones are generated, which, after traversing the Atlantic, finally spend their violence on the British coasts. They have this further element of interest, that the great circulating current of the surface waters of the North Atlantic Ocean, the existence and nature of which have been confirmed by my experiments with floats, passes close to the north of them, but without touching them. Two of these islands are already in telegraphic communication with each other and with Europe.

Bermuda also forms a very useful point of observation, because it lies almost on the other extremity of the arc of the circle, along which the North Atlantic cyclones pass, and near to the meridian where they most frequently curve back and direct themselves towards Europe. Bermuda is in direct telegraphic communication with North America and Europe. Observations are already made there, but are not telegraphed to Europe.

The Azores are situated not far from the centre of the same circle, which is also that of the great vortical circulation-current of this part of the ocean. A submarine cable, to connect the Azores with Portugal and with America, is at present under construction, and will shortly be laid.

Madeira occupies a position in the neutral zone, which separates the trade-wind regions from those of the south-westerly winds of higher latitudes.

As this region shifts with the season, this island belongs sometimes to the one region and sometimes to the other. Madeira is connected with Portugal by a duplicate cable.

The Canaries lie in a region, where the trade-winds take their rise, and prevail during the greater part of the year. Three of these islands, namely, Tenerife, Grand Canary, and La Palma, are connected with one another, and with Europe, by submarine cable.

With the exception of Bermuda, all these islands have localities suitable for high-level observatories, which, if established and kept going for only a single year, would help greatly to put the meteorology of the North Atlantic on a sure and scientific basis.

In the Azores there is Pico, 7613 feet, Madeira has an elevation of 6056 feet, Tenerife over 12,000 feet, and in the Cape Verde the island of Fogo 9760 feet. I consider that in several of these mid-Atlantic stations, where a certain number of ships and steamers call, it will often be possible to complete the daily meteorological information, with

observations gathered by the said ships in the surrounding region during twelve hours before their arrival. The information would thus concern not only a spot, but a radius of perhaps one or two hundred miles.

With regard to the execution of the project, I should suggest the following general lines: The points selected would be, Bermuda; the Azores, with an observatory at the sea-level at Fayal, and one on the summit of the mountain Pico, in the neighbouring island; the island of Madeira; the Canaries (Tenerife); and one on the Cape Verds, with an auxiliary station on Fogo summit.

Great Britain might undertake the installation and maintenance of the observatory in Bermuda.

The other observatories should be supported at the joint cost of the nations most interested.

At each observatory the staff should consist of an observer and one assistant. The observations ought to include barometer, hygrometer, thermometer, wind, and clouds.

As the observations would belong to an altogether distinct category, it would be well that they should be transmitted in the first instance to an observatory or establishment devoted to their special consideration; and I am willing that they should be collected at Monaco, where the Government will undertake their discussion, publication, and distribution.

Shortly, my plan is this. The western shores of Europe, especially those of Great Britain and Ireland, are exposed to continual devastation by storms which come from the westward. The only source from which we obtain warnings is the continent of North America, and the warnings thence received are of considerable value. But the width of the North Atlantic is so great that American storms lose themselves, and others are generated of which Europeans, under present circumstances, can receive no warning. The American *Pilot Chart* supplies abundant evidence that there are many destructive storms which devastate our coasts, of which ample warning could be given if we were in telegraphic communication with a well-organised meteorological observatory in the Azores. The admirable observations made by Piazzzi Smyth on the Peak of Tenerife, in the summer of 1856, give most valuable hints in connection with the establishment of observatories such as we have under consideration. The conditions, as regards temperature and humidity, would be quite distinct on the summits of all the islands named from the conditions at sea-level. As regards the winds, it is possible to speak with certainty only about the loftiest, that is the peak of Tenerife. Even its summit is not always above the upper level of the trade-winds. The summit of Fogo (9760 feet), judging from Smyth's observations at his intermediate station, Guajara (8843 feet), would lie very near the surface, separating the lower and the upper systems of circulation. It is probable that both the summit of Madeira and Pico in the Azores would be more often in the lower than in the upper system. But the observations on Ben Nevis show that, for purposes of weather-forecasting, this would be rather an advantage than otherwise. The results already given by the discussion of four years'

observations on Ben Nevis justify the confident expectation that similar high-level observations in the middle of the Atlantic would give results of equal, and probably much greater, importance for useful and timeous weather-forecasting.

It is with great satisfaction that I find myself able to inform the British Association that the French Submarine Telegraph Company, the contractors for the line between the Azores and Europe, are bound by the terms of their concession to transmit daily three free telegrams of ten words each from the Azores to Europe, and in the opposite direction, and a like number between the Azores and North America.

I propose that next winter delegates chosen by the nations interested should meet at Monaco to discuss this important question, each of them bringing the help of his experience.

## THE TRIBES OF MASHONALAND AND THEIR ORIGIN.

(*Read at Meeting of British Association, 1892.*)

BY J. THEODORE BENT.

THE inhabitants of the newly-opened-out country in South Africa, which has somehow or other got the name of Mashonaland, are an oppressed and impoverished race of Kaffirs, raided upon by Zulus, on the one hand under Lobengulu, and on the other hand under Gungunyana.

They now dwell amongst the rocks and crannies of the mountains, whither they flee at the approach of the enemy, and look down upon the destruction of their homesteads and the robbery of their cattle. They are obviously a race which has seen better days, retaining amongst them traces of a higher civilisation in their skill in smelting iron, their carvings and ornamentations, their musical instruments, and many other kindred points.

During our stay amongst them last year for a period of seven months we had an opportunity of closely studying their characteristics, the chief points of which I propose to place before you in this paper.

From the Lundi river on the south, and indefinitely northwards towards the Zambesi, the inhabitants, though of different tribes, all call themselves by one race-name, and this name is *Makalanga*. "You will find many Makalanga there," was the encouraging reply to inquiries when we started off on our trip to the Sabi river, an unexplored region. "A Makalanga is buried there," and phrases such as this are common to the countries ruled over by Chibi, Guto, Gambidji, and Mtigeza, where they are all known as Makalanga, the probable derivation of which name is *Ma-ka-langa*, an Abantu word signifying "children of the sun." This name did not convey much to me until, on my return to civilisation, I read the works of early Portuguese travellers, and in the account of Dos Santos, written 300 years ago, who, by the way, is almost the only Portuguese writer on the subject of this country who does not indulge in extravagant exaggerations, I found, to my astonishment, the following